

To the extent that NISA addresses marine species, it does so almost exclusively in the context of ballast-water discharges, despite the existence of many other vectors. Ballast-water exchange (BWE) is a procedure in which ships in the open ocean dump ballast water taken aboard in foreign ports. Its purpose is to lessen the chance of introducing coastal invasive species into potentially hospitable habitats in destination ports. However, BWE does not always dislodge species and it does not apply to coastwise travel, which can also allow species to be transported to new environments. Additionally, BWE is not mandatory under NISA. Although the U.S. Coast Guard is required to check ship logs to determine whether an exchange occurred, it is not required to check the ballast tanks. Current guidelines encourage ship operators to report voluntary exchange, but compliance with this minimal requirement is weak.

There is little law focusing on other vectors of invasive species. For example, there is no uniform regime in place to track live imports either entering or traveling around the country. There is no systematic process for determining which management approach is best when a species is found, no central source of information for researching species, and no dedicated source of funding to control invasive species. For species like the destructive seaweed, *Caulerpa taxifolia*, which grows as much as three inches a day, any delay in response could have severe environmental and economic ramifications (Box One).

Currently, agencies at different levels of government report commodities using a different nomenclature and verification system. With

such inconsistency, neighboring states could simultaneously be working to promote and eradicate the same species, and one agency's food list could be another agency's most wanted list of invaders. The lack of regulatory clarity was brought home by the discovery of the invasive snakehead fish in a Maryland pond. Federal regulations did not prohibit the importation or interstate transportation of this Asian fish and state law provided only a mild penalty for release of the fish, for which the statute of limitations had expired. Furthermore, state managers had no clear legal authority to eradicate the population that had established itself. This type of confusion results in invasive species—literally—slipping through the regulatory cracks and getting into the environment without anyone noticing.

SOUND

The use of anthropogenic sound as a tool in the ocean has become enormously valuable for scientists, engineers, fishermen, and the military. It allows fishermen to locate schools of fish and to keep predators from raiding or becoming entangled in their nets. The use of sound also helps mariners detect icebergs and other obstructions, biologists study behavior changes in marine species, oceanographers map the bottom of the ocean floor, geologists find oil and gas, climatologists research global climate change, and the U.S. Navy detect submarines.

Many marine species, including marine mammals, turtles, and fish, also rely on sound. They use vocalizations and their ability to hear to detect predators, prey, and each other. In the oceans, as on land, sound is essential

for communication.

Anthropogenic sound in the ocean is on the rise, mainly due to increased vessel traffic. Coastal development is bringing more pleasure craft, and globalization and international trade require more commercial vessels. In addition, the navies of the United States and other nations are increasingly using active sonar systems to patrol coastal waters for enemy submarines. Meanwhile, oil and gas operations on the outer continental shelf are expected to spread into deeper waters. Climate change, too, may have a significant effect on sound levels in the ocean. Not only does sound travel faster in warmer water, but also rising temperatures and melting ice at the poles may open new shipping channels in areas that have previously experienced little vessel traffic.

Sound sources differ in both their inten-

sity and frequency, and thus can have varied effects on species. Sounds in the same frequency ranges used by marine species can mask acoustic communication among animals and interfere with detection of prey and predators. High-intensity sounds can cause pain and, in some circumstances, tissue and organ damage. If the pressure resulting from the sound is intense enough, the animal can experience internal bleeding and subsequent death.

A mass stranding of whales in 2000 heightened concerns about the effects of sound in the oceans. In March of that year, at least 17 whales were stranded on beaches in the northern Bahama Islands. Most of the animals were alive when they stranded and eight of them were returned to the sea. The other nine animals died; pathology reports revealed bruising and internal organ damage. The stranding occurred about the time that ten U.S. Navy vessels were operating their mid-frequency sonar systems nearby. Investigations conducted cooperatively by the Navy and the National Marine Fisheries Service suggested that the sonar transmissions were a critical factor in the strandings (NOAA, 2001).

Low-intensity sounds can disrupt behavior and cause hearing loss, ultimately affecting longevity, growth, and reproduction. Frequent or chronic exposure to both high- and low-intensity sounds may cause stress, which human and terrestrial animal studies indicate can affect growth, reproduction, and ability to resist disease. Impulse sounds, such as those produced by explosions and seismic air guns, may damage or destroy plankton, including fish eggs and larvae, as well as damage or



Tim Aylen/Vision Media

Local children examine a whale stranded in the northern Bahama Islands in 2000. During March, at least 17 whales beached themselves subsequent to Navy sonar operations nearby. Investigations suggested that the sonar transmissions were a critical factor in the strandings.

destroy tissues and organs in higher vertebrates (Hastings et al., 1996; Gisiner, 1999).

The Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA), and the National Environmental Policy Act (NEPA) all provide legal mechanisms for addressing sound. However, the MMPA and ESA apply only to marine mammals and endangered species, and are only capable of protecting individuals from particular sound-related projects, such as drilling operations or sonar activities. In addition, the federal government has recently proposed to exempt certain activities from environmental review under NEPA. Because review under these statutes is triggered only on a case-by-case basis and does not effectively address cumulative impacts on marine ecosystems, underwater sound as a source of potentially significant pollution in the marine environment has not received comprehensive treatment. A new policy framework is needed to adequately address this emerging pollution concern.

ACTION TO REDUCE MARINE POLLUTION

For too long our oceans have been dumping grounds. Within U.S. waters, ecosystems are subjected to insults from nonpoint, unregulated point, and nontraditional types of pollution from both land- and ocean-based sources. Nutrients, toxics, cruise ship discharges, acoustic and biological pollution, and invasive species all harm marine ecosystems, and the legal regimes in place do not match the nature of today's pollution threats. For each of these pollution sources, policy changes can and should be made as quickly as possible.

SUMMARY OF RECOMMENDATIONS

1. Revise, strengthen, and redirect pollution laws to focus on nonpoint source pollution on a watershed basis.

EPA and the states should establish water quality standards for nutrients, especially nitrogen, as quickly as possible. EPA and the states should also ensure that water quality standards are in place for other pollutants—such as PAHs, PCBs, and heavy metals such as mercury—where these are identified as problematic on a watershed-by-watershed basis. Congress should amend the Clean Water Act to require the use of best management practices to control polluted runoff resulting from agriculture and development. Congress and the executive branch should provide substantial financial and technical support for the adoption of such practices. Congress should link the receipt of agricultural and other federal subsidies to compliance with the Clean Water Act. Finally, Congress and the Environmental Protection Agency should ensure that air emissions of nitrogen compounds, mercury, and other pollutants are reduced to levels that will result in a substantial reduction of their impact on marine ecosystems.

2. Address unabated point sources of pollution.

Concentrated animal feeding operations should be brought into compliance with existing provisions in the CWA. Congress should enact legislation that regulates wastewater discharges from cruise ships under the CWA by establishing uniform minimum standards for discharges in all state waters and prohibiting discharges with-

in the U.S. Exclusive Economic Zone that do not meet effluent standards. Congress should amend NISA to require ballast-water treatment for all vessels that travel in U.S. waters, and regulate ballast-water discharge through a permitting system under the CWA. Finally, the International Maritime Organization draft convention on ballast-water management should be finalized and its provisions implemented through appropriate U.S. laws.

3. Create a flexible framework to address emerging and nontraditional sources of pollution.

A national electronic permitting system should be created under NISA to facilitate communication and track imports of live species that may result in aquatic introductions. Each state should inventory existing species and their historical abundance, in conjunction with the development of the regional ocean governance plans under the National Ocean Policy Act. Congress should provide adequate funding for developing statewide invasive-species management plans that include provisions for inventorying, monitoring, and rapid response. With regard to sound, a comprehensive research and monitoring program should be developed to determine the effects

of sound sources on living marine resources and ecosystems. Consideration should be given to requiring the utilization of best-available control technologies, where the generation of sound has potential adverse effects. Finally, the environmental ramifications of any sound-producing project should be taken into formal consideration—pursuant to NEPA or other applicable statutes—at the planning stages of the project, before significant resources, time, and money have been devoted to its development.

4. Strengthen control of toxic pollutants.

The U.S. should ratify the Stockholm Convention on Persistent Organic Pollutants (POPs), and implement federal legislation that allows for additions to the list of the "dirty dozen" chemicals. In concert with this effort, EPA should develop and lead a comprehensive monitoring program to quantify levels of particular toxic substances in designated ocean habitats and species, and sufficient resources should be devoted to studying the effects of toxics on marine species. This monitoring program should be coordinated with Food and Drug Administration and EPA seafood contaminant advisory efforts, so that people know where their seafood comes from and what it contains.